ERDC/GSL TR-13-27

Geotechnical and Structures Laboratory

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Full-Scale Evaluation of DuraDeck® and MegaDeck™ Matting Systems

Timothy W. Rushing and Lyan Garcia

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Geotechnical and Structures Laboratory
US Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Final report

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Abstract

The purpose of this report is to present results from full-scale evaluations of DuraDeck® and MegaDeck™ matting systems. Both systems were evaluated under simulated aircraft traffic and 25-kip forklift traffic to determine their ability to carry aircraft and heavy vehicle loads over typical soil conditions encountered during contingency operations. The objective of the evaluation was to determine if either the DuraDeck® or MegaDeck™ matting system is a suitable alternative to AM2 matting for use as hangar and shelter flooring for the US Air Force Basic Expeditionary Airfield Resources (BEAR) kits. The test results showed that the DuraDeck® matting system was unable to sustain a significant number of aircraft or 25-kip forklift passes over typical natural subgrade conditions, and the MegaDeck™ matting system was unable to sustain a significant number of aircraft passes. For either system to become a suitable alternative to AM2, additional strengthening of existing soil at the hangar or shelter would be required before mat system installation.

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Preface

The US Army Engineer Research and Development Center (ERDC) was tasked by Headquarters, Air Combat Command of the US Air Force, to evaluate Signature Systems Group, LLC's, DuraDeck® and MegaDeck™ matting systems under simulated aircraft traffic and 25-kip forklift traffic. The mat systems were evaluated over a subgrade with a California bearing ratio (CBR) of 6. The results of these evaluations were used to determine if either system was a suitable alternative to AM2 for use as flooring for temporary hangars and shelters as part of the Basic Expeditionary Airfield Resources (BEAR) kits. The investigation reported herein was sponsored and program management provided by Air Force Civil Engineer Center-East (AFCEC-East), Tyndall Air Force Base, Florida.

This publication was prepared by personnel of ERDC's Geotechnical and Structures Laboratory (GSL), Engineering Systems and Materials Division (ESMD), and Airfields and Pavements Branch (APB). The findings and recommendations presented in this report are based on full-scale tests and analyses conducted at ERDC in January 2013. The Principal Investigators for this study were Timothy W. Rushing and Lyan Garcia, APB. Technical oversight was provided by Jeb Tingle, ESMD. The research team included Quint S. Mason and Chase Bradley, APB; Jamie Davis and Les Newton, Bevilacqua Research Corporation; and Stacy Washington and Leroy Hardin, ERDC Directorate of Public Works. Rushing and Garcia prepared this publication under the supervision of Dr. Gary L. Anderton, Chief, APB; Dr. Larry N. Lynch, Chief, ESMD; Dr. William P. Grogan, Deputy Director, GSL; and Dr. David W. Pittman, Director, GSL.

At the time of this evaluation, COL Kevin J. Wilson was Commander and Executive Director of ERDC. Dr. Jeffery P. Holland was Director.

Acronyms and Terms

ACC	Air Combat Command
AFCEC	Air Force Civil Engineer Center
BEAR	Basic Expeditionary Airfield Resources
CBR	California bearing ratio
CH	High-plasticity clay
COTS	Commercial off-the-shelf
ERDC	US Army Engineer Research and Development Center
HDPE	High density polyethylene
MHE	Material handling equipment
USAF	US Air Force

Unit Conversion Factors

Multiply	By	To Obtain
feet	0.3048	meters
inches	0.0254	meters
pounds (force)	4.448222	newtons
pounds (force) per square inch	6.894757	kilopascals
square feet	0.09290304	square meters

1 Introduction

Purpose

The purpose of this report is to present results from full-scale evaluations of DuraDeck® and MegaDeck™ matting systems. DuraDeck® was evaluated under simulated aircraft and 25-kip forklift traffic, and MegaDeck™ was evaluated under simulated aircraft traffic to determine each system's ability to carry loads over typical soil conditions encountered during contingency operations.

Objective

The objective of the evaluation was to determine if either the DuraDeck® or MegaDeck™ matting system is a suitable alternative to AM2 matting for use as hangar and shelter flooring for the US Air Force's (USAF's) Basic Expeditionary Airfield Resources (BEAR) kits.

Background

USAF BEAR kits consist of lightweight, air-transportable assets that are used to erect a mobile, temporary airbase. These kits assist the military in rapidly deploying a force that is fully capable of supporting sustained combat operations in the same manner as a fixed theater installation. Because the concept is to construct a base where one previously did not exist (bare base), the kits include shelters, power, waste treatment, and airfield support systems. The BEAR kits are undergoing modernization to ensure that included assets are lighter and less lift-intensive.

One material included in the kit is AM2 airfield matting, which is used for flooring. Because of its weight and expense, other lightweight commercial-off-the-shelf (COTS) flooring systems for hangars and other shelter flooring systems were evaluated to determine the most suitable for inclusion in the BEAR kits.

DuraDeck® was identified as a potential candidate system by the US Air Force Air Combat Command (ACC). Signature Systems Group, LLC, the producer of DuraDeck®, agreed to send test panels to the US Army Engineer Research and Development Center (ERDC) for evaluation. In addition, the company sent a more robust system, MegaDeck™, for

evaluation. The US Air Force Civil Engineer Center (AFCEC) agreed to sponsor the evaluation. George VanSteenburg, AFCEC, and Wil Jean, ACC, attended the evaluation as USAF representatives. Don Couvillon, Vice President of Heavy Duty Matting, Signature Systems Group, LLC, attended the evaluation as a representative of the matting systems' manufacturer. Engineers Timothy W. Rushing and Lyan Garcia, and Airfields and Pavement Branch (APB) staff, conducted the evaluation with support of other ERDC staff.

This report describes the DuraDeck® and MegaDeck™ matting systems in Chapter 2 and the construction of the full-scale test section and installation of the matting systems in Chapter 3. Chapter 4 describes the data collection and failure criteria, and the results are given in Chapter 5. Conclusions and recommendations are noted in Chapter 6.

2 Description of the Matting Systems

The following paragraphs briefly describe the DuraDeck® and MegaDeck™ matting systems. Additional information can be obtained from product literature on the Signature Systems Group, LLC, website (DuraDeck, n. d.). A summary of both systems' properties is shown in Table 1. AM2 properties are also included for comparison. Approximate costs shown for DuraDeck® and MegaDeck™ were provided by the vendor for informational purposes only. Actual product costs can vary significantly based on quantities ordered and contractual requirements.

Table 1. Mat properties.

Property	DuraDeck®	MegaDeck™	AM2
Length (ft)	8	14 (actual), 13 (usable)	12
Width (ft)	4	7.5 (actual), 6.5 (usable)	2
Thickness (in.)	0.625	4.25	1.25
Weight (lb)	86	1,150	145
Unit Weight (lb/ft^2)	2.68	10.95	6.1
Rate of installation (ft^2/man hr)[a]	320	305	240
Panel Cost (government rate)	$180.00	$1,800.00	$886.00
Unit Cost (government rate per ft^2)	$5.63	$21.30	$36.91
Number of panels in 20-ft ISO Container	250	20	122[b]
Number of square ft in 20-ft ISO (ft^2)	11,200	1,690	2,916[b]
Weight of fully-loaded 20-ft ISO (lb)	21,500	23,000	21,984[b]

[a] Installation rate calculated by the installers during this evaluation.

[b] Shipping quantities estimated from Navy shipboard 20-ft flat rack configuration.

DuraDeck®

The DuraDeck® matting system, shown in Figures 1 and 2, is made up of 4-ft-wide-by-8-ft-long-by-0.625-in.-thick panels. These panels come in standard colors of white, black, and sand, but can be customized. The panels are constructed of a proprietary blend of high-density polypropylene (HDPE) plastic that is compression- molded into a solid panel with a non-skid surface molded onto each face. Each panel weighs 86 lb and can be installed by two men without the assistance of material handling equipment (MHE). Panels are connected by placing metal plates studded with threaded

Figure 1. DuraDeck® mat panel, top surface.

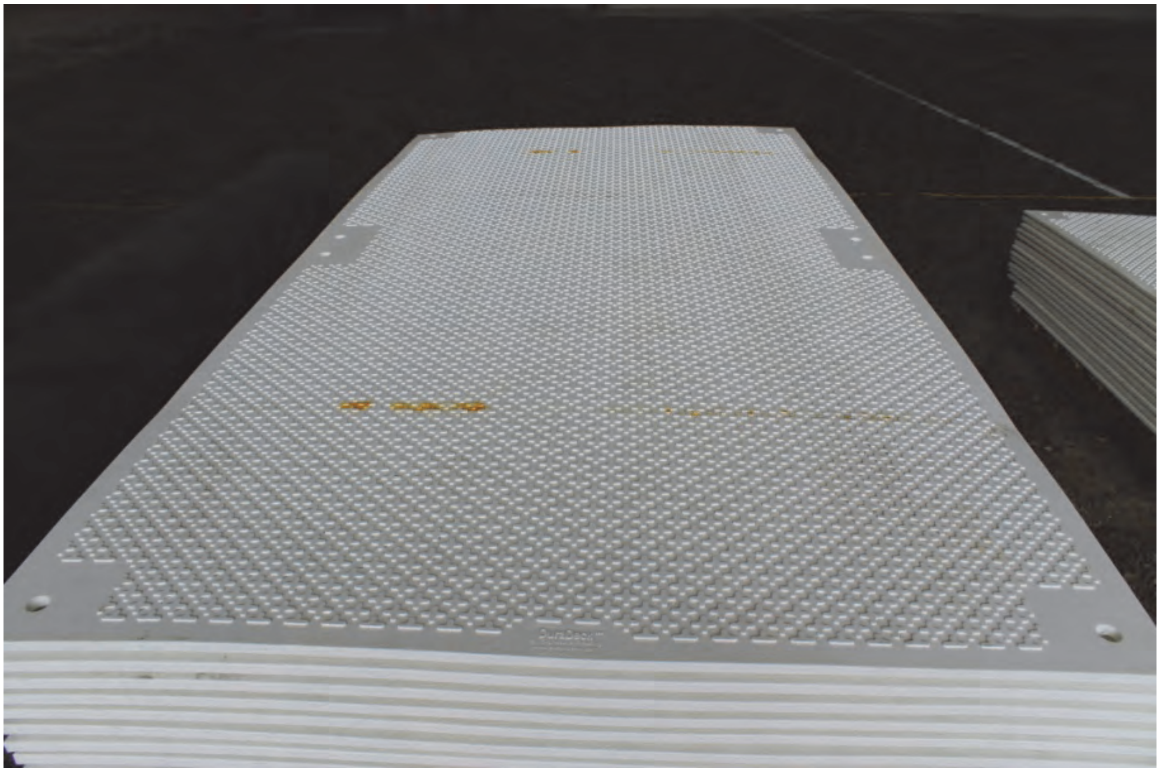


Figure 2. DuraDeck® mat panel, bottom surface.

bolts, as shown in Figure 3, underneath the mat corners and then installing special connector nuts from the top surface to secure the mats together. According to the manufacturer, the panels will not degrade with sun or aircraft fluid exposure. If anchoring is required by the user, COTS duckbill anchors are recommended to keep the surface from moving during operations; however, anchoring is not required by the manufacturer.

MegaDeck™

The MegaDeck™ matting system, shown in Figure 4, is made up of 7.5-ft-long-by-14-ft-wide-by-4.25-in.-thick panels with a usable surface area of 6.5 ft by 13 ft. The panels are sand in color and made of a proprietary blend of HDPE plastic compression molded into a hollow structural system in the interior core of the panel. The bottom surface of each panel is plastic welded to the skin/core assembly. Both the top and bottom skins have non-skid surface profiles so that the panels are reversible. Two individual panels are permanently connected with mechanical fasteners to create a full panel. Each panel weighs approximately 1,100 lb and must be placed using MHE. Panels are connected by locking pins (Figure 5) that are dropped into assembly slots from the surface and rotated 90 deg with a specialized T-handle tool to lock adjacent panels together, as shown in Figure 6. According to the manufacturer, the panels will not degrade with sun or aircraft fluid exposure. If anchoring is required by the user, COTS Manta Ray anchors are recommended to keep the surface from moving during operations; however, anchoring is not required by the manufacturer.

Figure 3. DuraDeck® metal plates and connector nuts.

Figure 4. MegaDeck™ mat panel.

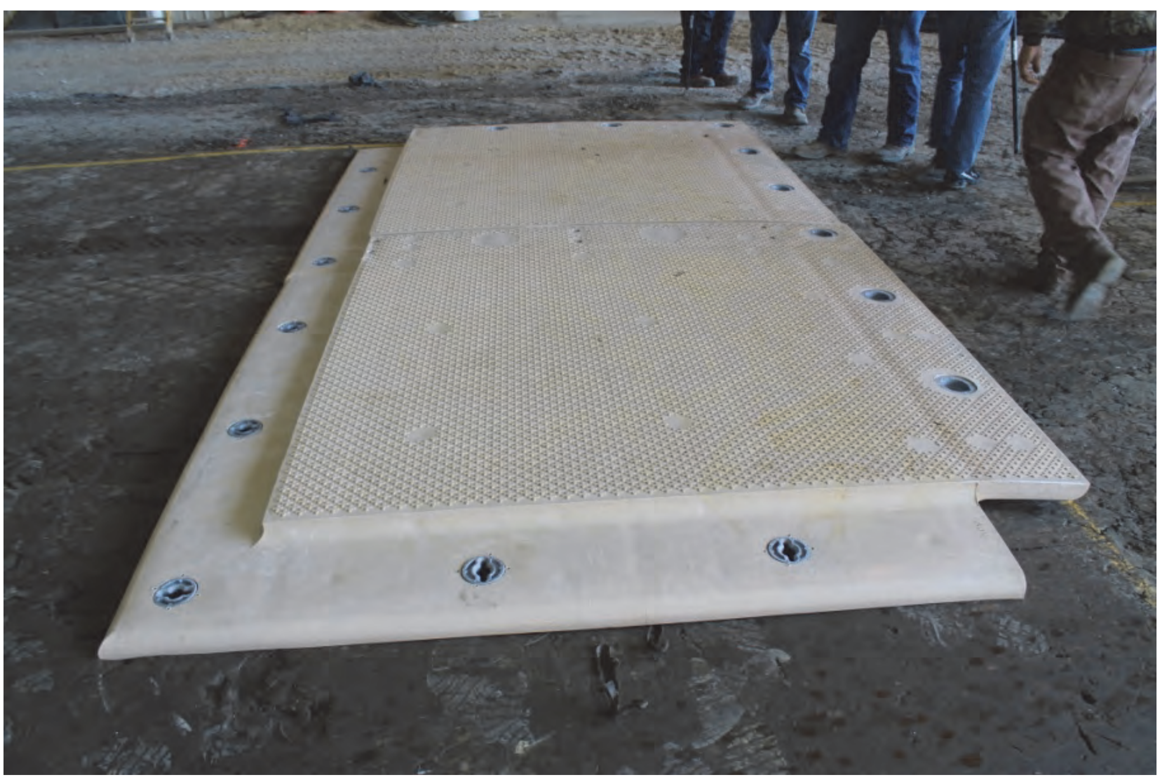


Figure 5. MegaDeck™ locking pin and rubber washer.

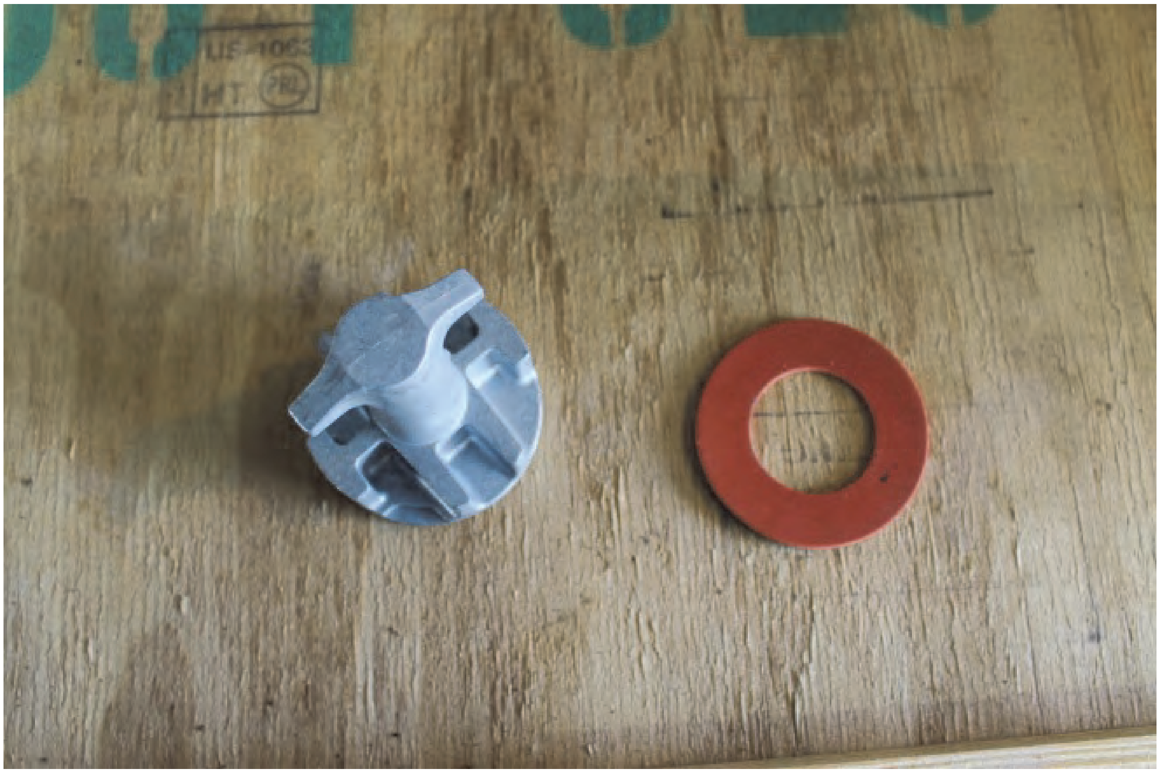
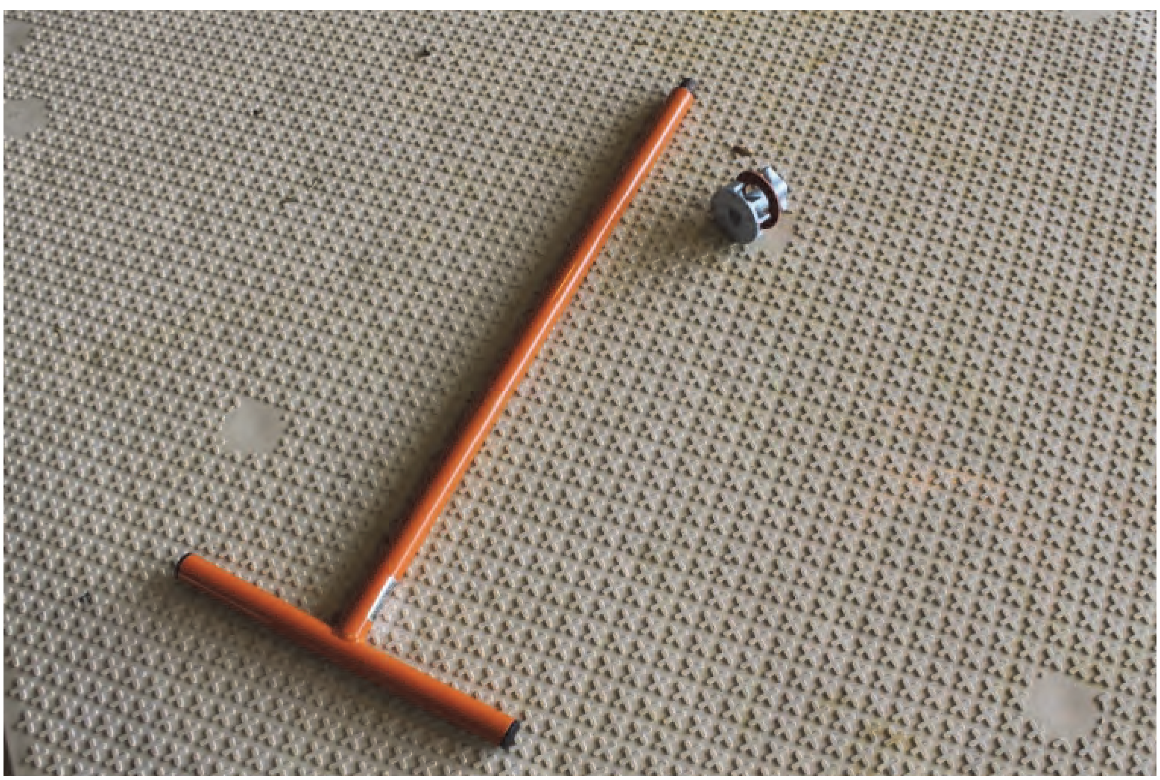


Figure 6. MegaDeck™ T-handle tool.



3 Test Section Construction

The minimum subgrade strength requirement for mat placement in aircraft operation areas is a CBR of 6 for the USAF. The 6-CBR requirement ensures the majority of soils encountered around airfields meets the bearing capacity requirement with minimal ground preparation, i.e., grading for smoothness and compacting with self-propelled compactors. For temporary hangar and shelter construction, the same minimum subgrade requirement is expected. Therefore, the evaluation of the DuraDeck® and MegaDeck™ matting systems was conducted over a 6-CBR minimum strength subgrade.

The field evaluation of the two matting systems was conducted in the Hangar 4 Pavement Test Facility at the US Army ERDC in Vicksburg, Mississippi. A soil-surfaced area reserved for mat testing was utilized for field testing. A subgrade was prepared for mat installation by removing the existing soil from a 60-ft-wide-by-40-ft-long area to a depth of 36 in. A high-plasticity clay with Unified Soil Classification System classification of CH was processed until the moisture content was approximately 33 %, so that a 6-CBR subgrade could be constructed. The test pit was lined with plastic to prevent moisture migration into the neighboring soil, and the processed CH material was installed in the pit in 6-in.-thick lifts until the surface was level with the hangar floor. Each compacted lift was tested to ensure 6-CBR strength had been reasonably achieved. Once all the CH material was placed and compacted, a motor grader was used to smooth the surface and create a level test bed for mat installation. After the DuraDeck® test was complete, no re-work of the soil surface was required. The traffic centerline was shifted to an undisturbed area to avoid influence from localized deformations before the MegaDeck™ matting system evaluation.

The following sections describe the installation processes for the DuraDeck® and MegaDeck™ matting systems. Both mat test sections covered an area of the test bed approximately 40 ft wide by 40 ft long. Pallets of individual mat panels and connectors were moved to an area adjacent to the test section by a forklift prior to installation. A crew of five personnel installed the mat systems. None of the installers had any experience with either system before installation. A representative of Signature Systems Group, LLC, instructed personnel on how the mats should be assembled during test-section construction.

DuraDeck®

According to the manufacturer, the DuraDeck® matting system performs best over soft, fine-grained soils when a geotextile fabric is installed on the soil surface (DuraDeck® Installation, n. d.). A standard, non-woven needle-punched geotextile was recommended. The geotextile keeps soil from coming through the panel joints and working its way onto the panel surface. The geotextile also offers some tensile resistance to reduce the permanent deformation in the subgrade. A 12.5-ft-wide by 360-ft-long roll of 6-oz. non-woven geotextile was acquired for the evaluation. The roll weighed approximately 120 lb and had a diameter of about 18 in. Three 40-ft-long sheets of geotextile were cut from the roll and placed side-by-side with 12-in. overlaps on the CH test bed prior to mat installation as shown in Figure 7.

Figure 7. Geotextile-covered test bed.

The DuraDeck® panels were installed without the use of MHE. Panels were removed from the shipping pallets by two men and were carried into position on the geotextile-covered CH test bed. Panels were assembled in a brickwork configuration so that the longitudinal joints were not continuous. The first panel was placed flat on the subgrade along a pre-determined baseline. Metal connector plates studded with threaded bolts were placed

underneath two pre-drilled corners of the panel. The plates were positioned so that the adjacent panel's opposite pre-drilled corners lined up over two other threaded studs on the same plates, allowing the panels to be connected. Once the second panel was positioned over the threaded connectors, nuts were installed on the threaded studs from the top side of the panels to fasten them securely. This process was continued until the entire panel array was complete. Each of the connector nuts was hand-started, then tightened using a cordless drill with a socket designed to fit the nuts. During installation, the manpower was divided as follows: two men carried the panels into position and aligned the bottom connector plates, two men hand-started connector nuts, and one man tightened the nuts with a cordless drill. After one hour of installation, the array of panels was complete. Assembly time was calculated and resulted in approximately 320 ft^2/man-hr. Greater efficiency could have been gained by using a second cordless drill for tightening the connector nuts. Eight nuts were required for each interior panel, and six were required for edge panels. Half-panels were not used for this test; however, they are available from the manufacturer to ensure a square or rectangular array can be assembled with complete coverage of the area. Photos demonstrating installation of the DuraDeck® panels and the final layout of the test section are shown in Figures 8 through 11.

MegaDeck™

The MegaDeck™ panels required MHE for installation. Panels were removed from the shipping pallets by an all-terrain forklift and were carried into position on the CH test bed as shown in Figure 12. No geotextile was required prior to MegaDeck™ installation. Panels were assembled in a block array with continuous longitudinal joints according to manufacturer recommendations (MegaDeck™, n. d.). Panels were designed with underlap edges perpendicular to each other on two sides and overlap edges on the opposite sides. The overlap edges were positioned in the corner of the assembly so that the direction of construction was along the perpendicular underlap edges.

The adjacent panels were moved to the test section by forklift. They were guided into position by inserting steel guide rods through connector holes in the overlap portion of the second mat and into the matching connector holes in the underlap edge of the first mat as shown in Figure 13. Once the second panel was on the subgrade, the guide rods were used as levers to adjust the position of the second mat so that connector pins could be easily

Figure 8. DuraDeck® panel installation.

Figure 9. Tightening DuraDeck® connector nuts.

Figure 10. Connected DuraDeck® joint.

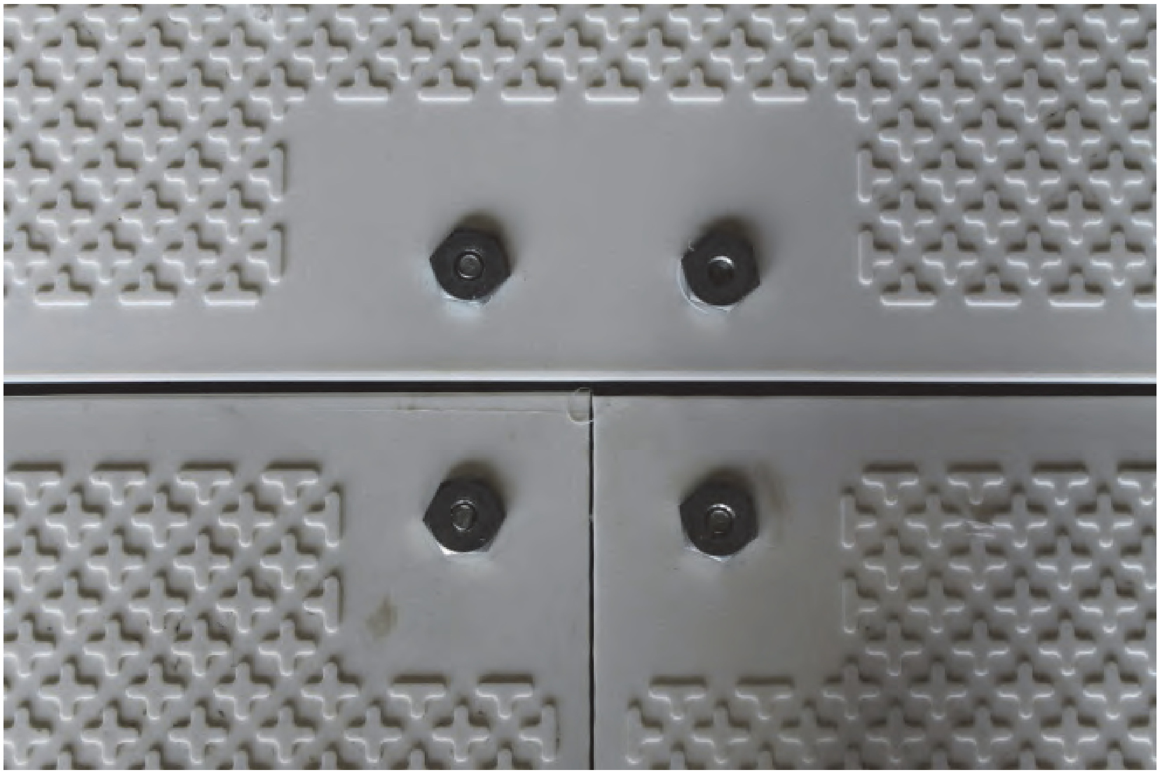


Figure 11. Final layout of DuraDeck® test section.

Figure 12. Positioning MegaDeck™ panel with an all-terrain forklift.

inserted into the matching connector holes in the two panels as shown in Figure 14. Once the connector pins were inserted into the provided slots, a specialized T-handle tool was used to rotate the locking pins 90 deg and lock the two panels together as shown in Figure 15. Eight connector slots were supplied for each mat panel. This process was continued until the entire panel array was complete. During installation, the manpower was divided as follows: one forklift operator carried the panels into position, two men used steel guide rods to position the mats, and two men inserted locking pins into the connector slots and locked them into place with the supplied T-handle tool. After one hour of installation, the array of panels was complete. Assembly time was calculated and resulted in approximately 305 ft^2/man-hr. Additional efficiencies were gained as the forklift operator and installers became more familiar with the procedure. A photo of the final layout of the MegaDeck™ test section is shown in Figure 16.

Figure 13. Guiding MegaDeck™ panels into position with guide rods.

Figure 14. Installing MegaDeck™ connector pin.

Figure 15. Locking MegaDeck™ connector pins with T-handle tool.

Figure 16. Final layout of MegaDeck™ test section.

4 Experimental Program

Test vehicle description

The following sections describe the test vehicles used for this evaluation.

F-15E

The F-15E model is the most damaging aircraft in USAF inventory to pavement surfaces because of its high tire pressure and heavy single-wheel loading. A fully armed F-15E has a gross weight of 81,500 lb and a single-wheel loading of 35,235 lb with a tire pressure of 325 lb/in^2. This gross vehicle weight and wheel load are not representative of aircraft using a temporary hangar facility; therefore, the load was reduced from maximum gross weight to a standard weight of 68,500 lb to represent an un-armed aircraft. The resulting single-wheel load was 29,395 lb. A simulated F-15E load cart, equipped with an F-15E tire and wheel assembly, was loaded to the required weight and used for trafficking. This load cart, shown in Figure 17, was specially designed to test both pavement and matting surfaces to determine aircraft compatibility.

Figure 17. Simulated F-15E load cart.

25-kip forklift

The heaviest wheeled vehicle believed to utilize the BEAR shelters is the 25 kip capacity forklift. Based on vehicle data, the front axle when lifting a loaded 20-ft ISO container is 59,560 lb with a single-wheel load of 29,780 lb and a tire pressure of 80 lb/in^2. The exact vehicle was not available for testing; however, a single-wheel C-17 load cart was used to match the required loading and tire pressure, as shown in Figure 18. The contact area of the tire might have differed slightly than that of the actual forklift; however, the test vehicle closely matched the specifications and should give comparable results in terms of determining compatibility. The test vehicle was specially designed to test both pavement and matting surfaces.

Figure 18. Simulated 25 kip forklift load cart.

Data collection procedures

The following sections describe procedures used during the evaluation to determine when failure of each system was reached in terms of the number of passes. Two modes are used to determine failure of matting systems: one is permanent deformation of the subgrade, and the other is breakage of the mat panels. Permanent deformation limits can vary for different aircraft based on sensitivity of the on-board instruments to roughness in the operating surface. For the F-15E, deformation is limited to 1.25 in. For wheeled vehicles, there are no roughness limits. However, large

deformations in the subgrade might impede movement and cause operational concerns. Mat breakage failure is typically limited to 10% of the panels in the traffic area becoming unusable or tire hazards; therefore, they require replacement.

Permanent deformation

Permanent deformation of the subgrade was monitored at intervals throughout trafficking. Two methods were used for observation as shown in Figures 19 and 20. First, a straight edge was placed across the traffic lane and then a ruler was used to measure the distance from the straight edge to the mat surface. Second, a robotic total station was used to record the changes in elevation along quarter-point lines painted transverse to the direction of travel during trafficking. The data collected were used to plot a profile of the deformation across the test vehicle's wheel path. The rate of deformation was recorded and is included in this report.

Mat breakage

Mat breakage was determined through visual observation and inspection of the trafficked mat panels throughout the process. Any changes to the panel's integrity were noted along with the associated number of passes.

Figure 19. Measuring permanent deformation with straightedge.

Figure 20. Measuring permanent deformation with robotic total station.

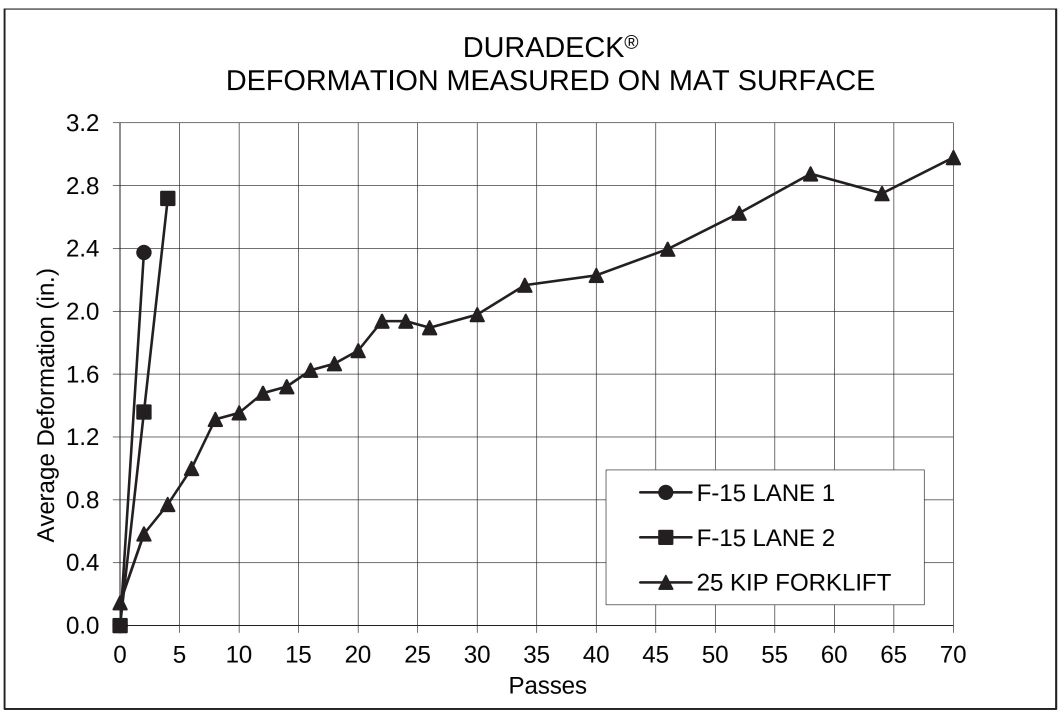
5 Test Results

The following sections describe the observations and results of data collection during trafficking of the DuraDeck® and MegaDeck™ matting systems.

DuraDeck®

The DuraDeck® evaluation consisted of trafficking with the simulated F-15E and 25 kip forklift. F-15E traffic was applied in two distinct traffic lanes. Lane 1 was positioned so that the test wheel was aligned directly along a longitudinal mat joint to simulate a worst-case trafficking scenario, since the longitudinal joints are unsupported. Lane 2 was positioned directly between the longitudinal joints so that all traffic crossed over the central portion of the mat panels and avoided the longitudinal joints, simulating a best-case scenario. The 25 kip forklift traffic was applied similar to Lane 1 for the F-15E, where the test wheel was aligned directly along a longitudinal mat joint. A summary of the rate of rut formation in each of the traffic lanes is shown in Figure 21. The discussion that follows explains these results.

Figure 21. Summary of subgrade deformation for DuraDeck®.



F-15E Lane 1

Trafficking with the simulated F-15E was first applied to Lane 1 of the test section. After the load cart completed one forward pass and one reverse pass, the matting panels along the joints were deeply embedded into the CH material. The entire area of the wheel path was deformed considerably. Measurements of rutting and permanent deformation showed the depth of rut averaged 2.4 in., as shown in Figure 21. Since the failure criteria limits permanent deformation to 1.25 in. for the F-15E, Lane 1 of the DuraDeck® matting was considered to have failed after two passes. No mat breakage occurred during trafficking. Photos of F-15E Lane 1 after complete trafficking are shown in Figures 22 and 23.

F-15E Lane 2

After trafficking of Lane 1 was completed, Lane 2 was designated over an area between longitudinal joints. After the load cart completed one forward pass and one reverse pass, the soil underneath the matting panels was considerably deformed. Deformation measurements exceeded 1.38 in., and Lane 2 failed by excessive deformation after 2 passes; however, traffic was continued since no tire hazard was presented. After two more passes, traffic was concluded since the permanent deformation averaged 2.75 in. as shown in Figure 21. The condition of the mat after trafficking is shown

Figure 22. DuraDeck® subgrade deformation after 2 passes on F-15E Lane 1.

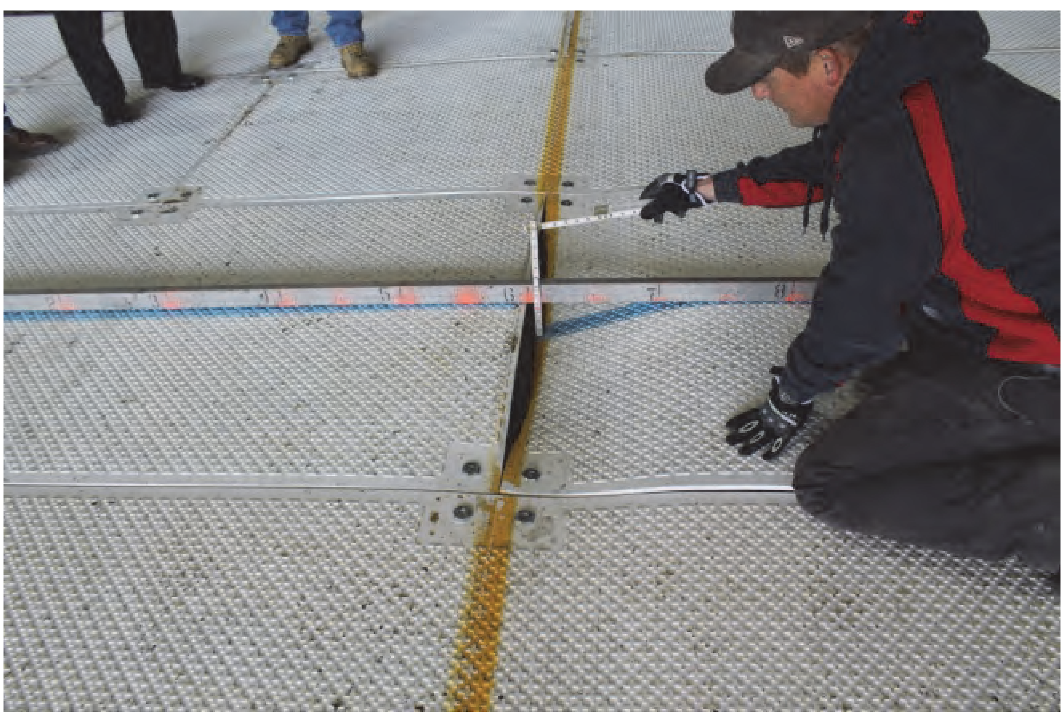
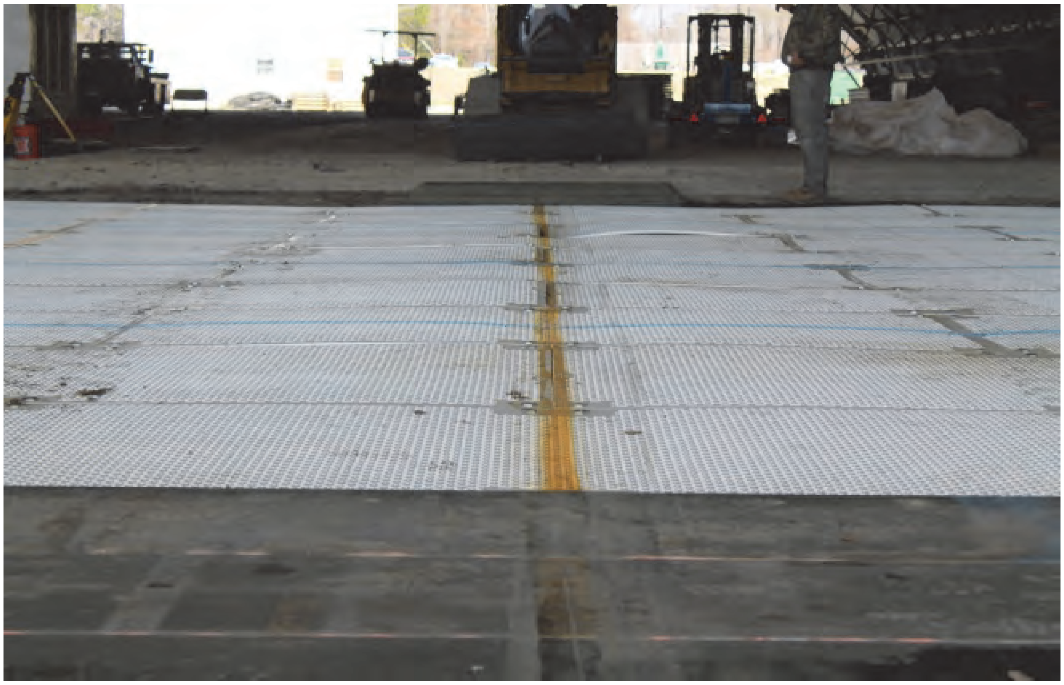


Figure 23. DuraDeck® F-15E Lane 1 after trafficking was concluded.



in Figures 24 and 25. Measurements shown in Figures 24 and 25 do not accurately represent the deformation on the mat surface at the end of trafficking. Since the mat panels were flexible enough to bridge over any deformation in the subgrade, a more accurate measurement could only be obtained if a small load (i.e., weight of one man) was applied on the surface to bend the mat. A total of four passes had been applied, and no mat breakage was noted.

25 kip forklift

Simulated 25 kip forklift traffic was applied on the DuraDeck® matting system. After 30 passes, a deformation of 2 in. was measured. Since there is no failure criterion in terms of permanent deformation for wheeled vehicles, trafficking was continued. The deformation continued to increase until it reached 3 in. after 70 passes, as shown in Figure 21. At that time, excessive deformation on the surface caused the wheel guards on the side of the test vehicle to nearly touch the mat surface. To avoid damage to the test vehicle, the test was concluded. Although there was significant movement of the matting during trafficking and large deformation in the subgrade, no damage to the matting or connection system was noted. Applied stresses from protruding threaded studs caused a slight elongation of connector holes in the mat, but the panels could be reused without concern or modification. Photos of deformation on the mat after concluding trafficking are shown in Figures 26 and 27.

Figure 24. DuraDeck® deformation after 4 passes on F-15E Lane 2.

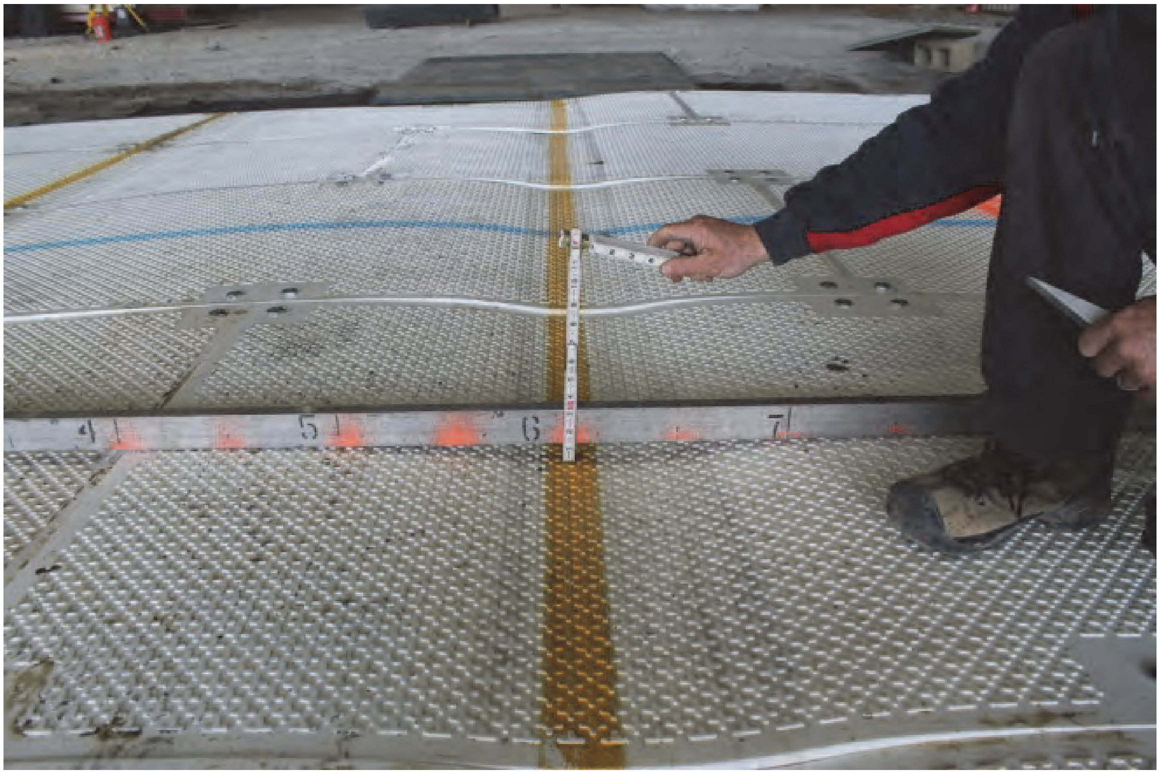


Figure 25. DuraDeck® deformation on F-15E Lane 2 after 4 passes.

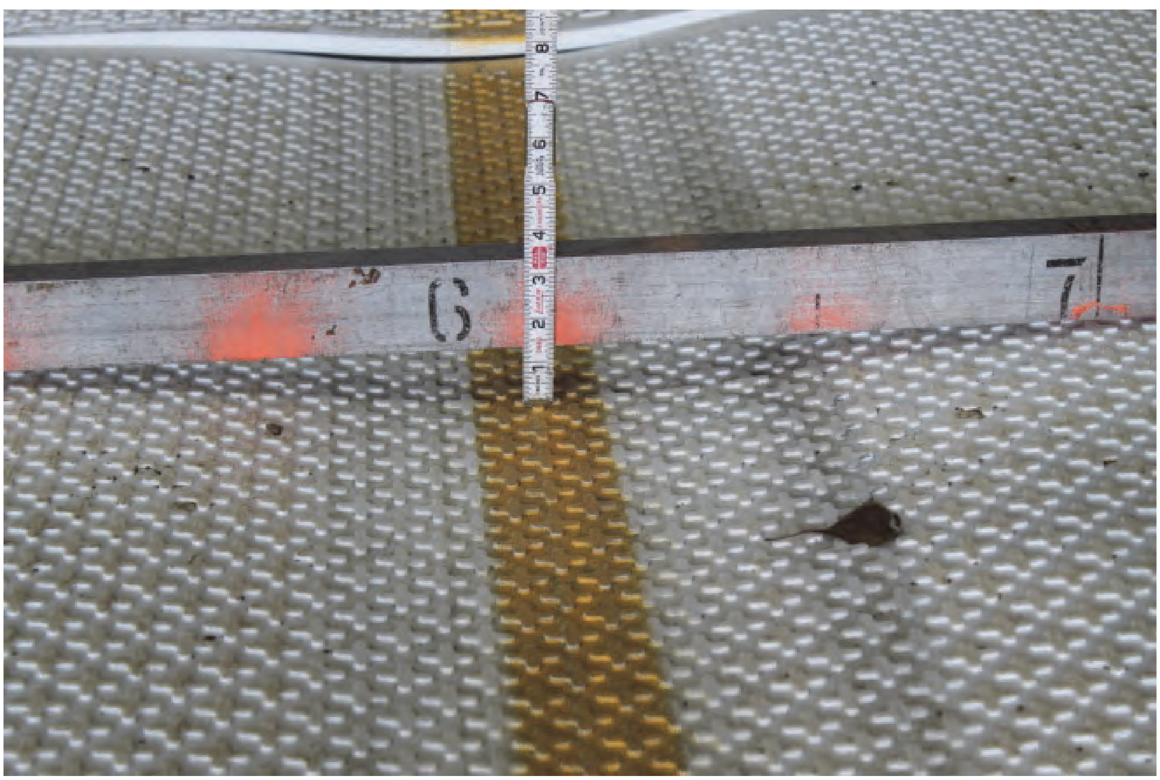
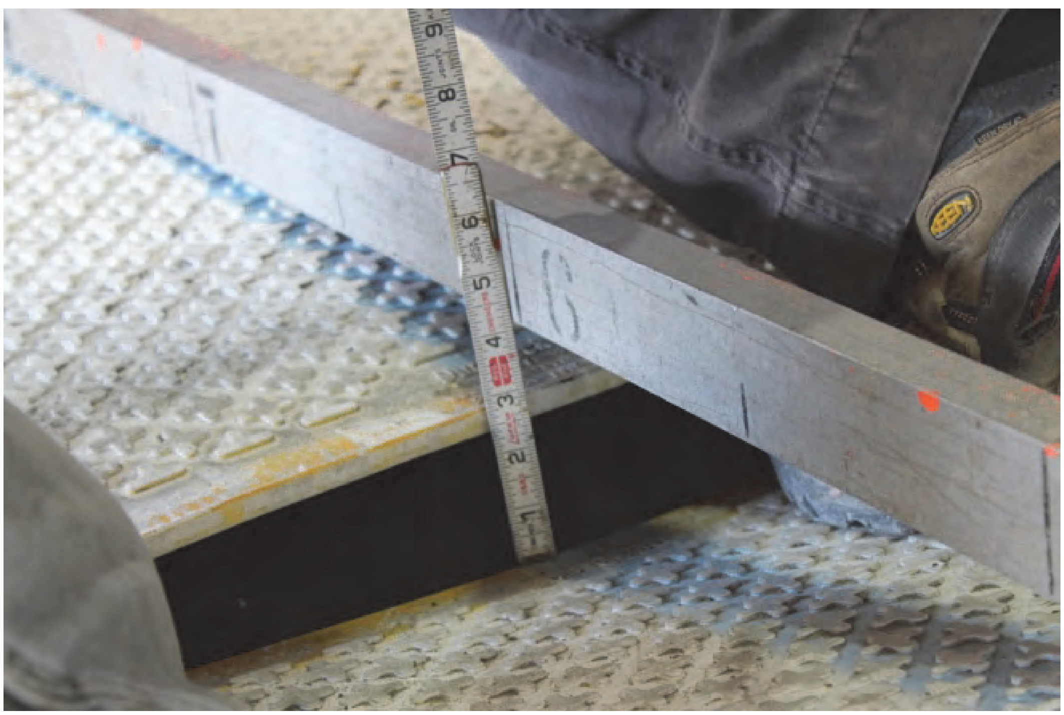


Figure 26. DuraDeck® final deformation on 25 kip forklift lane at connector plate location.

Figure 27. DuraDeck® final deformation on 25 kip forklift lane along unsupported joint.

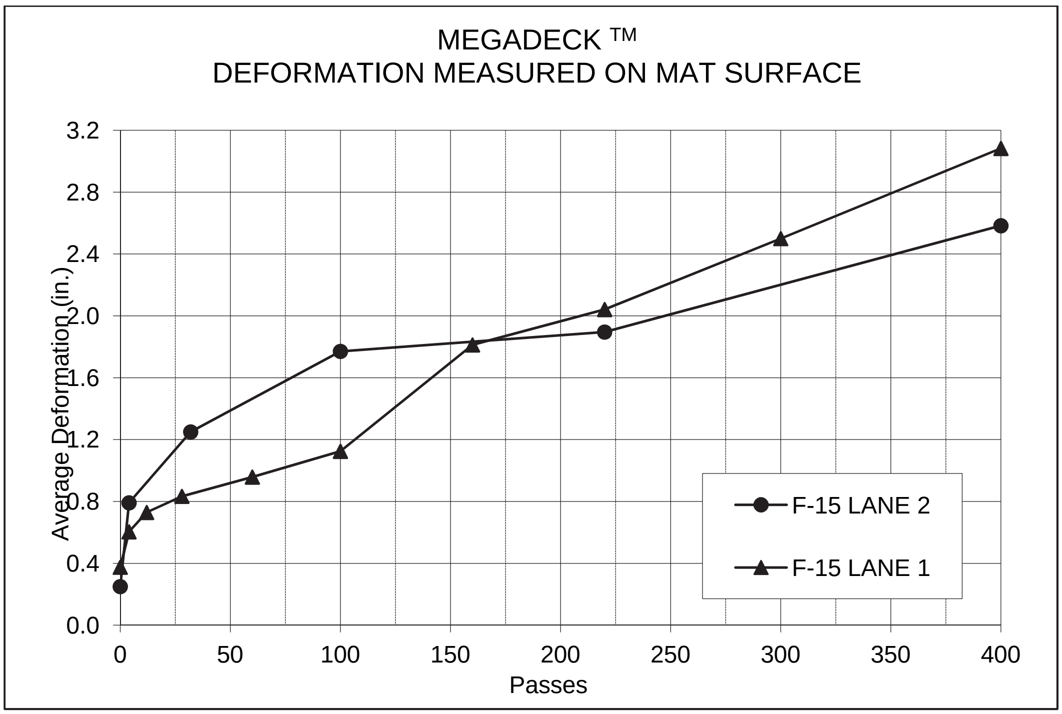


MegaDeck™

The MegaDeck™ evaluation consisted of trafficking with the simulated F-15E load cart only. F-15E traffic was applied in two distinct traffic lanes.

Lane 1 was positioned so that the test wheel was aligned directly along a continuous longitudinal mat joint. Lane 2 was positioned directly between two longitudinal joints. For Lane 1, a standard F-15E with a gross weight of 68,500 was simulated for the first 100 passes. Then, weights were added to the test vehicle to represent a fully-loaded F-15E with a gross weight of 81,500 lb for comparison to previous AM2 test results for outdoor parking apron applications. The maximum loading condition was applied for the remainder of trafficking on Lane 1 and for all trafficking of Lane 2. A summary of the rate of deformation in both traffic lanes is shown in Figure 28. The discussion that follows explains these results.

Figure 28. Summary of subgrade deformation for MegaDeck™.



F-15E Lane 1

Traffic began on Lane 1. After 160 passes, the permanent deformation was greater than 1.25 in., and the lane was considered to have failed by exceeding the deformation limits for the F-15E. Since no mat damage was noted and there were no tire hazards, trafficking was continued to observe response of the matting. The deformation on the mat surface continued until it was approximately 3 in. after 400 passes. Since the longitudinal joints were continuous, they acted as a hinge point, and the mat was free to rotate and embed into the soil. This freedom of rotation caused the rate of deformation to be quicker than initially expected. Inspection of the panels

after removal from the test section showed the bottom skin had begun to push through on the underlap side of the panels. This mat damage might have contributed to the rate of deformation in the wheel path. Figure 29 shows the final loaded deformation along the joint, Figure 30 shows a photo of the lane after trafficking was concluded, and Figure 31 shows a photo of the bottom skin damage.

F-15E Lane 2

Traffic was moved from Lane 1 to Lane 2 located between longitudinal joints to determine the difference in rates of deformation. After 32 passes, the permanent deformation was 1.25 in., and Lane 2 was considered to have failed by exceeding the deformation limits of the F-15E aircraft. Traffic was continued, since no breakage was noted. The deformation increased until 2.5 in. was measured after 400 passes. Minor cracking was noted on the surface of the skin, as shown in Figure 32; however, it did not pose a tire hazard. Trafficking was concluded to prevent instability of the load cart. The deformation on the surface caused the wheel guards on the side of the test vehicle to nearly touch the mat surface. The deformation on the mat surface after trafficking was concluded is shown in Figures 33 and 34. Lane 1 outperformed Lane 2, because the solid structure of the overlapping flanges

Figure 29. MegaDeck™ final loaded deformation along the joint on F-15E Lane 1.

Figure 30. MegaDeck™ final condition of F-15E Lane 1.

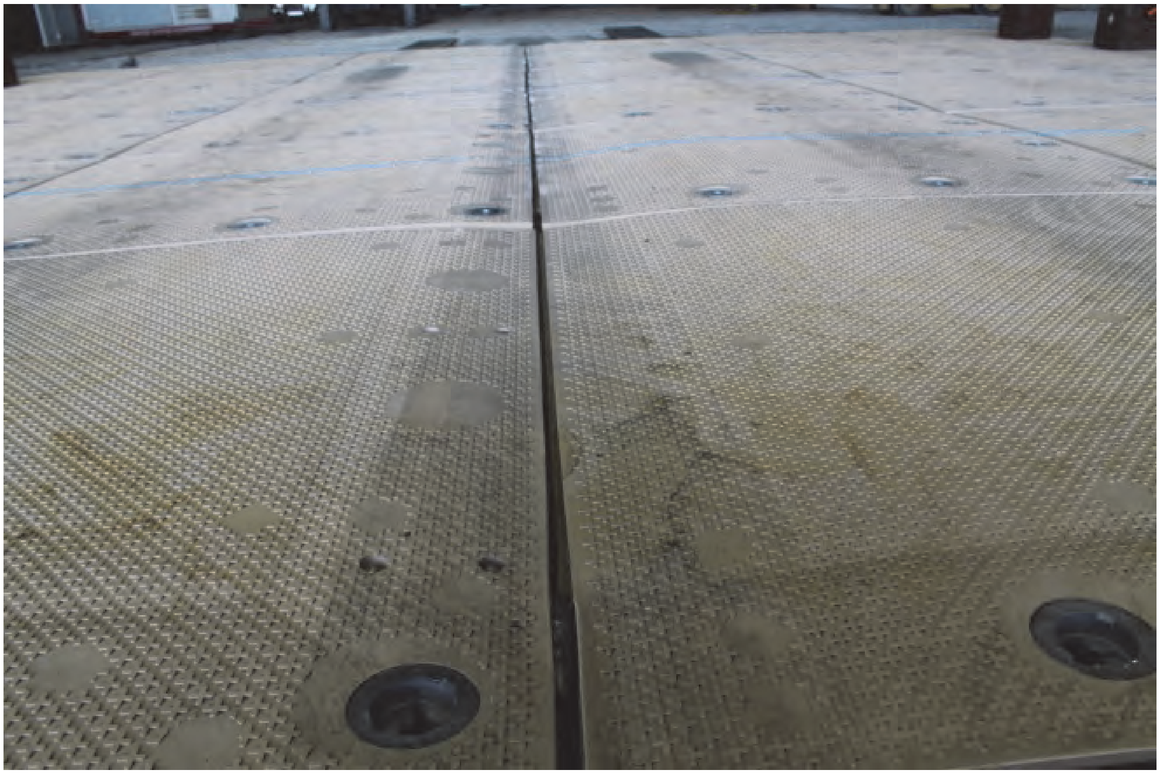
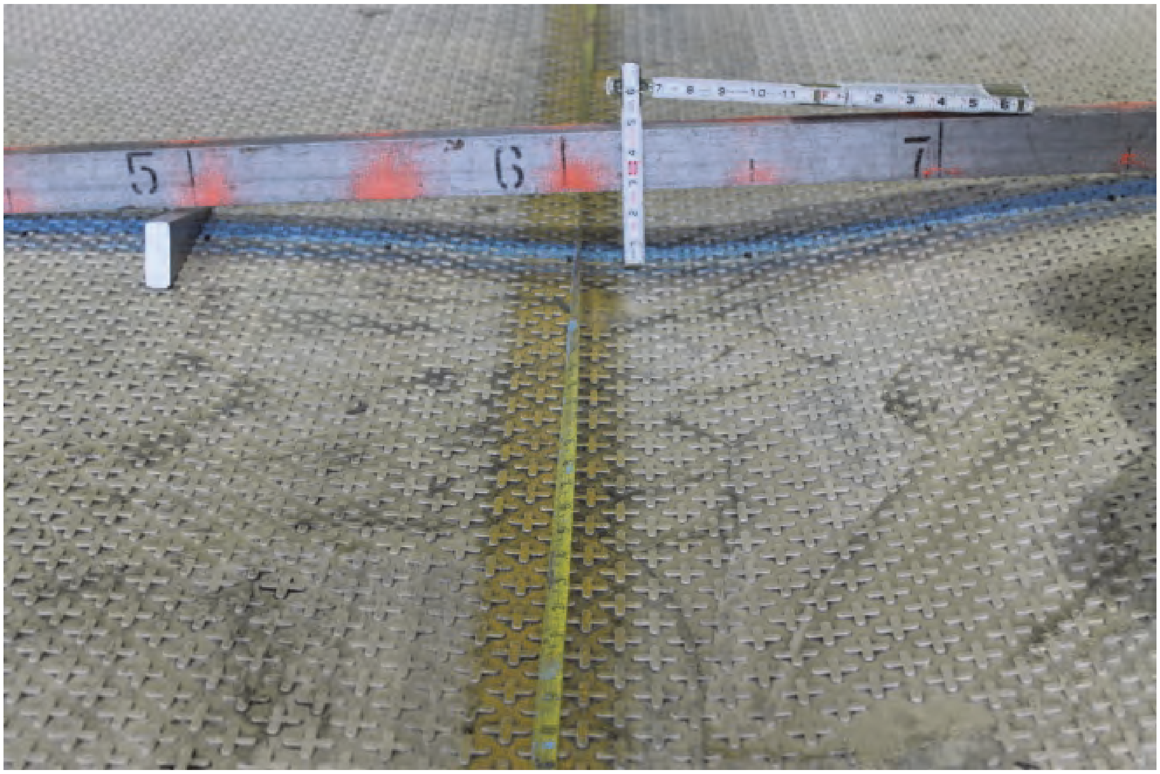


Figure 31. MegaDeck™ F-15E Lane 1 bottom skin damage.

Figure 32. Minor cracking on MegaDeck™ after 400 passes on F-15E Lane 2.

Figure 33. MegaDeck™ bottom skin debonding on F-15E Lane 2.

Figure 34. MegaDeck™ F-15E Lane 2 permanent deformation after trafficking concluded.



was able to handle the load better than the hollow structure of the mat's core. Once the MegaDeck™ panels were removed from the surface, researchers noted that the core of the individual panels had begun to crush, and the bottom skin was debonded from the panels as shown in Figure 35. Since this damage could not be seen from the surface and no tire hazard resulted, the actual number of passes before mat breakage occurred could not be determined. The damage resulted in earlier failure of Lane 2 over the central portion of the panels than Lane 1 with traffic along the joints.

Figure 35. MegaDeck™ F-15E Lane 2 after trafficking was concluded.

6 Conclusions

Based on the results from the full-scale traffic evaluation of the DuraDeck® and MegaDeck™ matting systems, the following conclusions were drawn.

1. The DuraDeck® matting system was able to sustain 2 passes of a simulated F-15E aircraft traffic with a gross vehicle weight of 68,500 lb and a tire pressure of 325 lb/in^2 when placed over a nonwoven geotextile-covered soil test bed having a CBR of 6. Two lanes were tested to simulate best and worst case trafficking scenarios, and both lanes failed by exceeding permanent deformation limits.
2. The DuraDeck® matting system was able to sustain 70 passes of a simulated 25 kip forklift with a gross vehicle weight of 59,560 lb and a tire pressure of 80 lb/in^2 when placed over a nonwoven geotextile-covered soil test bed having a CBR of 6 without damaging the matting; however, 3 in. of deformation occurred in the wheel path.
3. The MegaDeck™ matting system was able to sustain 100 passes of a simulated F-15E aircraft with a gross vehicle weight of 68,500 lb and an additional 60 passes with a gross vehicle weight of 81,500 lb when placed over a test bed having a CBR of 6 before reaching the 1.25-in. permanent deformation limit when trafficking along a continuous longitudinal joint.
4. The MegaDeck™ matting system was able to sustain 32 passes of a simulated F-15E aircraft with a gross vehicle weight of 81,500 lb when placed over a test bed having a CBR of 6 before reaching the 1.25-in. permanent deformation limit when trafficking between longitudinal joints. Significant mat breakage occurred to the underside of the mats that could only be seen after removal from the test section; therefore, the number of passes required to cause damage could not be determined.

AM2 conclusions

A full-scale test was conducted previously using AM2 matting under identical testing conditions as reported by Rushing and Tingle (2007). The following conclusions resulted from the AM2 evaluation and are included for comparison to the DuraDeck® and MegaDeck™ results.

The AM2 matting system was able to sustain 1,500 passes of simulated F-15E aircraft traffic with a gross vehicle weight of 81,500 lb and a tire

pressure of 325 lb/in^2 when placed over a soil test bed with a CBR of 6. The AM2 system failed by mat breakage.

Recommendations

Based on results of the full-scale evaluation of the DuraDeck® and MegaDeck™ matting systems, the following recommendations were determined:

1. For the DuraDeck® matting system to sustain a significant number of F-15E or 25 kip forklift operations (i. e., greater than 500), a 14-in. 50-CBR base would need to be constructed prior to laying the mat. This could require soil stabilization or the addition of suitable base material, such as crushed rock or gravel. The thickness and strength estimates above were computed using conservatively estimated modulus values for the matting system in the Pavement-Transportation Computer Assisted Structural Engineering (PCASE) software and are likely conservative. Additional testing is recommended to ensure a CBR of 50 is adequate to meet mission requirements.
2. For the MegaDeck™ matting system to sustain 1,000 passes of F-15E operations, additional strengthening of the soil underneath the matting is required similar to that for the DuraDeck®. The thickness and strength estimates above were computed and are likely somewhat conservative. Further testing is recommended to determine the appropriate soil strength needed to meet expected mission requirements in terms of passes to failure.

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MegaDeck™ Field Manual. (n. d.). http://www.duradeckmats.com/pdf/MegaDeck%20Field%20Manual.pdf

Rushing, T. W., and J. S. Tingle. 2007. *AM2 and M19 airfield mat evaluation for the Rapid Parking Ramp Expansion Program*. ERDC/GSL TR-07-5. Vicksburg, MS: US Army Engineer Research and Development Center.

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Timothy W. Rushing and Lyan Garcia

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Geotechnical and Structures Laboratory
US Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

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14. ABSTRACT

The purpose of this report is to present results from full-scale evaluations of DuraDeck® and MegaDeck™ matting systems. Both systems were evaluated under simulated aircraft traffic and 25-kip forklift traffic to determine their ability to carry aircraft and heavy vehicle loads over typical soil conditions encountered during contingency operations. The objective of the evaluation was to determine if either the DuraDeck® or MegaDeck™ matting system is a suitable alternative to AM2 matting for use as hangar and shelter flooring for the US Air Force Basic Expeditionary Airfield Resources (BEAR) kits. The test results showed that the DuraDeck® matting system was unable to sustain a significant number of aircraft or 25-kip forklift passes over typical natural subgrade conditions, and the MegaDeck™ matting system was unable to sustain a significant number of aircraft passes. For either system to become a suitable alternative to AM2, additional strengthening of existing soil at the hangar or shelter would be required before mat system installation.

15. SUBJECT TERMS

Airfield Mat	Road Mat	MegaDeck
Landing Mat	Temporary Surface	
	DuraDeck	

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